A Survey of the Softbottom Molluscs of Cockburn Sound, Western Australia

BY

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(7 Text figures)

INTRODUCTION

EARLY IN THIS CENTURY Petersen in a series of papers began quantitative investigations of marine level bottom communities. Following Petersen's work a number of studies were undertaken of the marine level bottom communities in various parts of the world. These are reviewed by THORSON (1957). Most of the early work was done in the North Atlantic, often in open sea areas. More recently studies have been initiated in restricted coastal marine embayments (SANDERS, 1960; RHOADS & YOUNG, 1970; POPHAM & ELLIS, 1971; DRISCOLL & BRANDON, 1973). Several studies have been done in the last several years in the Australian state of Victoria (POORE & RAINER, 1974; COLEMAN, 1976; CUFF & COLEMAN, 1979). The molluscan fauna of Cockburn Sound, Western Australia, is a classic example of a mollusc community of a marine soft bottom in a restricted embayment. This paper presents the results of a survey of the softbottom areas of Cockburn Sound.

PHYSIOGRAPHY

Cockburn Sound is the only large marine embayment along the 1300 km of the Western Australian coastline between Shark Bay on the west coast and King George Sound on the south coast. The Sound has an area of approximately 130 km² and is located at 32°12′S and 115° 43′E. The Sound is bordered on the east by the Australian mainland. Pt. Peron forms the southern boundary, Garden Island and Carnac Island the western border, and Parmelia Bank the northern extent (Figure 1). The margins of Cockburn Sound are primarily sandy beaches with a few rocky outcrops of aeolianite limestone.

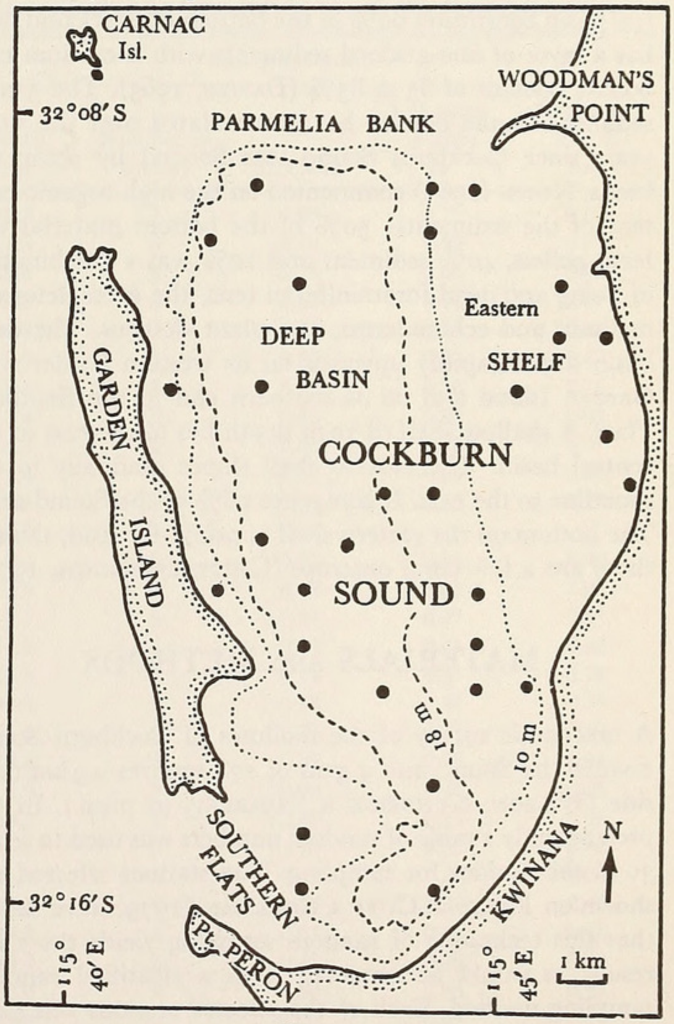

Figure 1

Physical features of Cockburn Sound, Western Australia

The Sound has a diverse marine flora and fauna and a high level of productivity (Chittleborough, 1970). It is located in a faunal overlap zone and has a mixture of tropical and warm temperate species (Wells, 1980). The rich marine biota has prompted a number of studies, most of which are unpublished theses done at the University of Western Australia. Published accounts of the biology of marine animals in Cockburn Sound include Wilson & Hodgkin (1967), Lenanton (1974) and Penn (1975).

Several benthic habitats are found in Cockburn Sound: open sand, beds of the seagrass *Posidonia*, rocky intertidal shores, isolated reefs of living and dead coral heads of *Turbinaria,* and softbottom areas. The latter are areas of muddy sand or mud bottoms which cover most of the area of the Sound.

The main feature of Cockburn Sound is the central basin, which has a uniform depth of 18 to 21 m. The central basin constitutes 60% of the bottom of the Sound, and has a layer of fine-grained sediments with a calcium carbonate content of 65 to 83% (Davies, 1963). The 5 m of sediment on the bottom has accumulated over the 5 000 years since Cockburn Sound was flooded by rising sea levels. Nunn (1966) commented on the high organic content of the sediments: 50% of the bottom material was fecal pellets, 40% sediment and 10% was a combination of living and dead foraminiferan tests, the exoskeletons of molluscs and echinoderms, and plant detritus. The deep basin slopes rapidly upwards on its western border with Garden Island and on its southern end to the Southern Flats. A shallow shelf of 10 m depth lies to the east of the central basin. The eastern shelf slopes gradually to the shoreline to the east. It comprises 26% of the Sound area. The bottom on the eastern shelf is primarily sand, though there are a few coral outcrops (Chittleborough, 1970).

MATERIALS and METHODS

A taxonomic survey of the molluscs of Cockburn Sound divided the Sound into a grid of 178 squares 0.9 km on a side (Wilson, Kendrick & Brearley, in prep.). In the present study a table of random numbers was used to select 30 of the stations for sampling. The stations selected are shown on Figure 2. Cuff & Coleman (1979) have shown that this technique of random sampling yields the same results as would be obtained from a stratified random sampling method. Each of the selected stations was sampled at the center of the square with a 0.1 m^2 Van Veen grab during the period of 27 February to 1 March 1978. The grab was operated from a 10 m motor launch, the M.V. *Henrietta.* Stations were located by triangulation from prominent features on the shoreline. Four replicate samples were made at the initial stations (16, 17, and 21) but the number of samples was reduced to 3 for later stations because of the quantity of material being collected. The bottom at stations 16, 17, 85 and 157 was covered with beds of seagrass *Posidonia australis.* The Van Veen grab did not function well in the seagrass beds, and data from these stations are only approximate. The bottom at the remaining stations was either sand or mud and the grab functioned with a high degree of effectiveness. The sampler was completely filled with 20 L of sediment on the majority of the hauls made in sand or mud bottoms.

A sediment sample of about 300 mL was removed from the first sample collected at each station prior to sieving. The sediment samples were frozen at the end of each day and remained frozen until they were analyzed. After the samples were thawed organic material was removed by

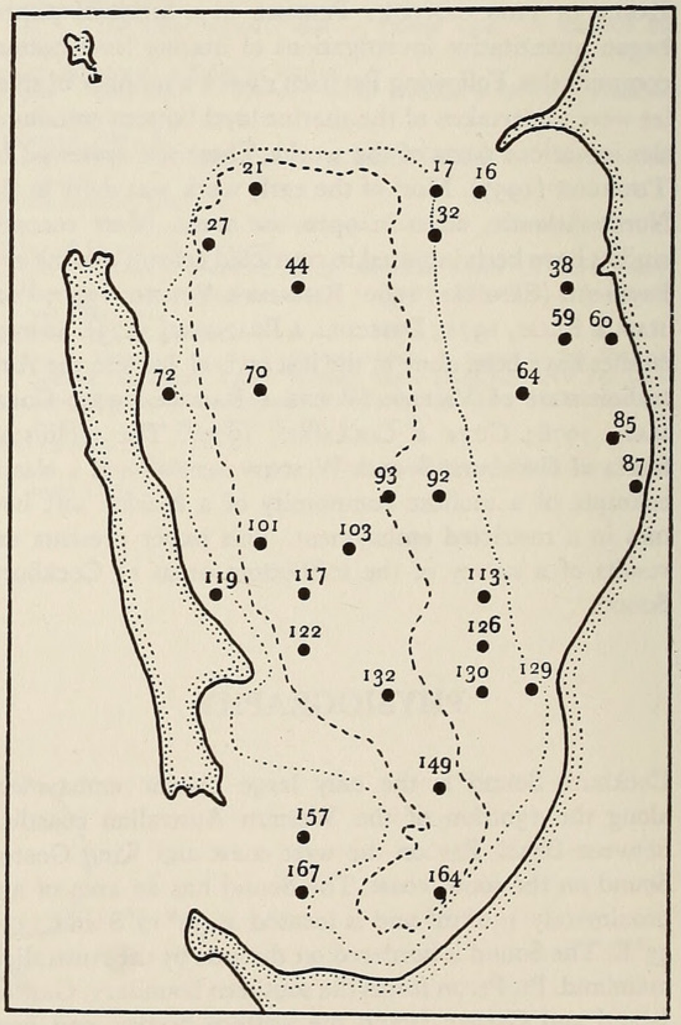

Figure 2

Stations sampled with a Van Veen grab in Cockburn Sound, Western Australia, during February and March 1978 heating the sediment to 50° C and adding hydrogen peroxide. The samples were stored at 50° C overnight. Addition of hydrogen peroxide the following morning produced no further reaction. The samples were wet sieved through a series of graded screens with mesh apertures of 1 000, 500, 250, 125 and 63 μm. Excess water was decanted from the finest fraction (after the sediment had settled) and all fractions were stored from 3 to 4 days at 80° C until they were completely dried. Each fraction was weighed separately and the weights for each station were converted to ø values (a geological measure of sediment grain size) on the Udder-Wentworth scale (Blatt *et al.*, 1972). The highest value of 5 is assigned to the fraction less than 63 μm and the lowest value of 1 is assigned to the fraction which passes through the 1 000 μm sieve but is retained on the 500 μm sieve. Sediment characteristics were determined using methods described in Sverdrup, Johnson & Fleming (1942) and Buchanan (1971). The sediment characteristics of each station are shown on Table 1.

After the 300 mL sediment sample was removed through the top of the Van Veen grab the remainder of the sample was sieved through a 1.7 mm mesh. Samples were sieved on board the M.V. *Henrietta* as they were collected. All material retained on the sieve was preserved in 10% for-

Table 1

Numerical characteristics of the sediments of the 30 stations investigated in Cockburn Sound, Western Australia.

Station	Sediment characteristics					Biological indices			
	Median ø	Sorting coefficient	Skewness	Percentage silts and clays	Depth (m)	Number of species	Simpson	Shannon-Wiener H′	Evenness H′/H max
16	2.1	0.48	+0.08	10.1	9.3	7	0.86	0.73	0.87
17	1.4	0.30	+0.05	0.0	11.4	6	0.79	0.69	0.89
21	1.4	0.50	+0.10	0.4	19.8	5	0.79	0.68	0.97
27	2.6	0.35	−0.75	30.0	19.8	6	0.65	0.64	0.82
32	3.2	1.22	−0.02	37.6	10.8	4	0.74	0.53	0.88
38	3.6	1.40	−0.45	48.0	9.9	5	0.82	0.62	0.89
44	4.0	0.58	−0.08	52.0	19.8	3	0.52	0.36	0.76
59	1.1	1.08	+0.28	6.9	8.4	5	0.84	0.66	0.93
60	3.5	1.20	−0.30	47.7	9.3	6	0.95	0.76	0.97
64	1.4	0.88	+0.18	6.5	8.4	10	0.94	0.96	0.96
70	4.5	0.58	−0.22	71.6	19.8	3	0.54	0.36	0.76
72	2.9	1.42	+0.18	40.9	12.6	1	—	—	—
85	4.2	0.60	−0.20	61.2	9.0	5	0.61	0.56	0.80
87	4.2	0.70	−0.20	57.4	3.6	2	0.02	0.02	0.08
92	3.8	0.88	−0.12	45.3	17.1	9	0.54	0.49	0.51
93	3.8	0.68	−0.12	39.5	18.0	6	0.48	0.41	0.52
101	4.6	0.58	−0.32	71.5	19.5	7	0.74	0.67	0.79
103	4.0	0.75	−0.20	51.0	19.8	5	0.58	0.47	0.68
113	4.3	0.65	−0.25	61.2	15.9	7	0.75	0.65	0.77
117	4.7	0.35	−0.15	80.2	19.8	8	0.85	0.79	0.88
119	4.6	0.30	−0.10	82.8	6.0	3	0.90	0.46	0.95
122	4.8	0.19	−0.04	87.7	19.2	4	0.86	0.55	0.92
126	4.7	0.22	−0.08	89.5	15.0	8	0.70	0.58	0.90
129	4.6	0.32	−0.08	81.8	15.6	6	0.64	0.49	0.64
130	4.7	0.30	−0.10	83.1	16.5	6	0.45	0.37	0.48
132	4.6	0.30	−0.12	80.8	19.2	4	0.67	0.49	0.82
149	4.7	0.25	−0.07	89.7	19.2	6	0.42	0.30	0.39
157	1.1	0.38	+0.10	3.9	2.0	8	0.86	0.84	0.93
164	4.8	0.22	−0.08	87.3	19.0	9	0..87	0.65	0.68
167	3.8	1.02	−0.32	46.2	6.9	3	0.83	0.46	0.96

malin buffered with borax. The samples were transferred to freshwater in the laboratory and sorted. All individuals that had been collected live were retained and stored in 70% alcohol. Individuals were sorted to species as completely as possible and counted. Specimens were blotted dry with paper towels and weighed to the nearest 0.1 g. Bivalve mollusc shells were broken open, the animal was blotted dry, and both animal and shell fragments were weighed together.

A Simpson and a Shannon-Wiener index were calculated for each station using the formulae presented by KREBS (1972) (Table 1). Overlaps between stations were determined by Jaccard's coefficient as described by POPHAM & ELLIS (1971). These data were used to construct a dendrogram using the techniques for the weighted pair group method using average linkage (SOKAL & SNEATH, 1963). The primary species of the community which occurs below the 10 m line were determined with the ranking method outlined by SANDERS (1960).

One of the key features in the structure of benthic communities is the channelling of energy resources between the constituent organisms of the community. To obtain a preliminary indication of the sources of energy utilized by the molluscs of Cockburn Sound the 34 species collected were assigned to the six feeding categories established by POORE & RAINER (1974). Little direct information is available on the feeding mechanisms and food preferences of Western Australian molluscs. While the details of feeding vary between species in a genus or family, the basic feeding mechanisms and types of food consumed are usually consistent. The assignments used here were based on the feeding mechanisms employed by taxonomically closely related species as reported by MORTON (1958), POORE & RAINER (1974) and THOMPSON (1976).

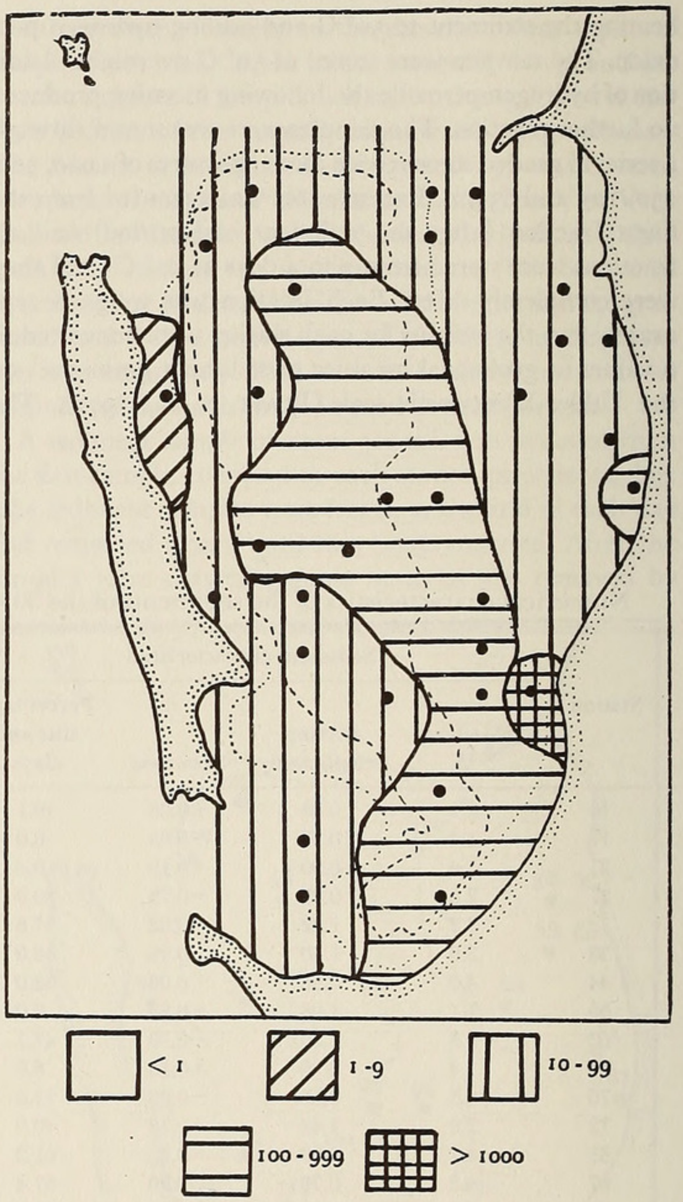

Figure 3

Density of molluscs (no./m²) collected in Van Veen grab samples made in Cockburn Sound, Western Australia, in February and March 1978

RESULTS

Distribution of molluscs:

A total of 138 species belonging to eight phyla were collected. Molluscs dominated the study. They constituted 72.19% of all individuals collected and 89.56% of the biomass. The dominance of molluscs can be attributed to bivalves, which alone comprised 71.30% of the total numbers and 85.18% of the total biomass collected. Amphineurans and gastropods were minor elements of the molluscan fauna; no cephalopods or scaphopods were collected. Coelenterates and echinoderms were the second and third most important groups in terms of numbers, but crustaceans and polychaetes were second and third in biomass. Thus, there was no group which was clearly second in importance. Because of the predominance of molluscs the discussion which follows will deal only with that group. A summary of the data on the molluscs collected is given in Table 2.

Figures 3 and 4 show the mean density and biomass of all molluscs collected at each of the 30 sampling sites. Low densities of animals were found in most stations in the

Table 2

Species of molluscs collected in Cockburn Sound, Western Australia.

Species	Number of individuals	Number of stations	Density (no/m²)		Weight (g/m²)	
			Mean	Maximum	Mean	Maximum
Class Amphineura						
Ischnochiton contractus (Reeve, 1847)	1	1	0.1	1.4	0.00	0.02
Ischnochiton sp.	2	2	0.2	3.3	0.04	0.69
Class Bivalvia						
Anomia cf. *A. trigonopsis* Hutton, 1877	254	10	28.1	473.3	21.37	317.97
Arcopagia (Pinguitellina) sp.	7	6	0.7	6.7	0.02	0.43
Chama ruderalis Lamarck, 1819	3	3	0.3	3.3	0.76	14.45
Circe sulcata Gray, 1838	149	18	16.2	141.1	16.82	163.87
Dosinia incisa (Reeve, 1850)	646	18	71.4	1551.2	222.26	1551.24
Epicodakia sp.	8	5	0.6	5.7	0.24	6.88
Fulvia aperta Bruguière, 1789	1	1	0.1	3.3	0.08	2.47
Hiatella australis (Lamarck, 1818)	10	6	1.1	13.3	0.07	1.05
Laternula creccina (Reeve, 1860)	2	1	0.2	3.3	0.11	3.23
Lithophaga sp.	1	1	0.1	2.5	0.01	0.18
Mactra ovalina Lamarck, 1818	1	1	0.1	3.3	0.04	1.26
Malleus meridionalis Cotton, 1930	1	1	0.1	3.3	3.85	115.43
Megacardita incrassata (Sowerby, 1825)	5	4	1.1	16.7	12.38	187.47
Musculista glaberrima Lamarck, 1819	874	23	96.2	640.0	48.41	507.82
Mytilus edulis planulatus Lamarck, 1819	3	1	0.3	10.0	6.61	198.37
Paphia crassisulca (Lamarck, 1818)	29	15	3.2	10.0	35.74	233.33
Phaxas cultellus Linnaeus, 1758	47	19	5.1	16.7	5.88	43.80
Solemya cf. *S. velesiana* Iredale, 1931	2	2	0.2	3.3	0.00	0.06
Tawera lagopus (Lamarck, 1818)	1	1	0.1	1.4	0.37	11.03
Tellina (Tellinangulus) sp.	1	1	0.1	3.3	0.02	0.51
Tellina (Tellinides) sp.	121	14	13.5	153.3	3.55	33.70
Theora lubrica (Gould, 1861)	1	1	0.1	3.3	0.00	0.05
Timoclea cardiocles (Lamarck, 1818)	3	1	0.3	3.3	0.03	0.88
Class Gastropoda						
Astralium tentorium (Thiele, 1930)	1	1	0.1	3.3	7.13	213.83
Bedeva paivae Crosse, 1864	2	2	0.2	2.5	0.25	0.40
Bulla botanica (Hedley, 1918)	4	1	0.4	13.3	0.15	4.43
Nassarius pauperus (Gould, 1850)	1	1	0.1	2.5	0.00	0.09
Pervicacia sp.	2	2	0.2	3.3	0.04	0.52
Polinices conicus (Lamarck, 1822)	1	1	0.1	3.3	0.50	14.96
Pyrene scripta (Lamarck, 1822)	1	1	0.1	1.4	0.02	0.57
Trigonostoma scalarina (Lamarck, 1822)	1	1	0.1	3.3	0.09	2.57
Vermetid sp.	3	1	0.2	7.5	0.12	3.55

northern area of Cockburn Sound (Figure 3), along the western side, and in the southern end of the Sound. Densities in these areas ranged from a minimum of 3/m² at Station 72 to a maximum of 330/m² at Station 87; most of the stations had densities less than 100/m². Only stations 44, 60, 87 and 164 were above that level. An area of high density was found in the mideastern portion of Cockburn Sound. This area encompasses Stations 92, 93, 103, 113, 126, 129, 130 and 149. Animal densities in this region ranged from a minimum of 160/m² at Station 103 to a maximum of 1367/m² at Station 129. The map of biomass for all molluscs collected (Figure 4) shows a similar high biomass for the mideastern sector of Cockburn Sound. Biomass figures at stations outside the mideastern region ranged from 0 g/m² at Station 72 to 330 g/m² at Station 60. The area of high biomass extends further west than the

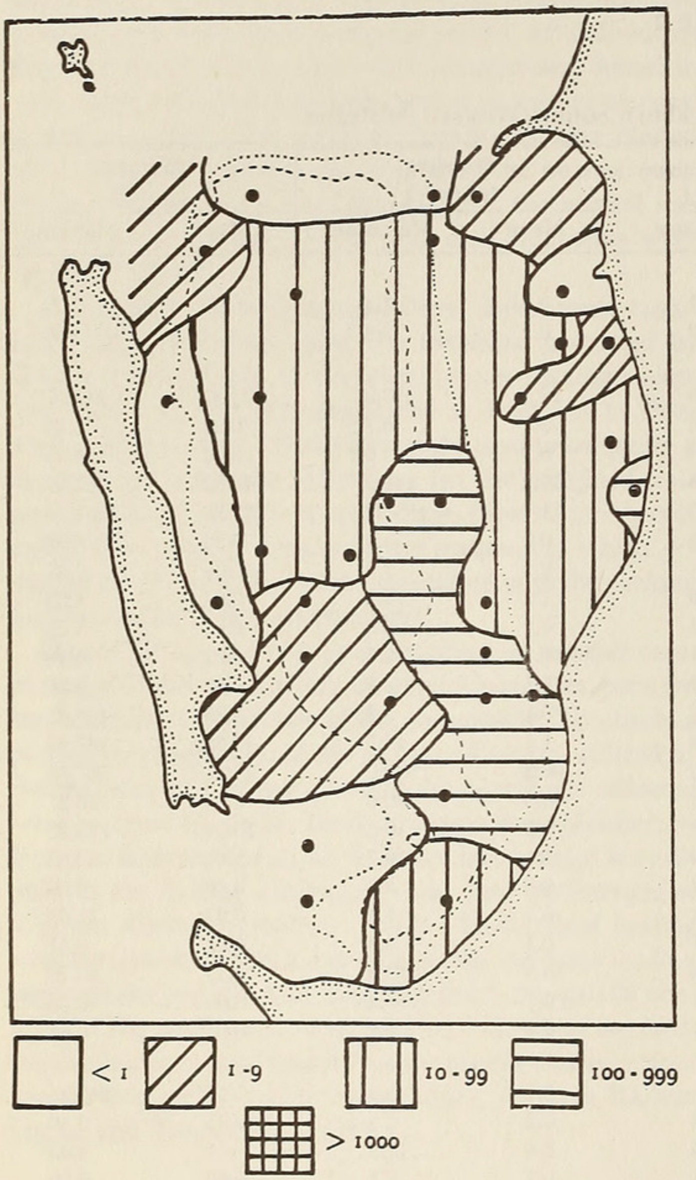

Figure 4

Biomass of molluscs (g/m²) collected in Van Veen grab samples made in Cockburn Sound, Western Australia, in February and March 1978

area of high density, and includes Stations 103, 117, 122, 132. Wet weights in the mideastern region ranged from 336 g/m² at Station 132 to 2027 g/m² at Station 126.

Two bivalves dominated the molluscan fauna of Cockburn Sound in terms of both density and biomass. *Musculista glaberrima* contributed 43.5% of the total number of molluscs but was only 12.5% of the biomass. *Dosinia incisa* constituted 32.3% of the numbers and 57.4% of the total biomass. The next most important species numerically were *Anomia* cf. *A. trigonopsis* and *Circe sulcata*.

The density of *Musculista glaberrima* follows the same pattern shown for all species collected and that for all molluscs. Densities of the species (Figure 5) were low over most of the Sound. The species was entirely absent at 7 of the 22 stations outside the mideastern region. The maximum density in the remaining 14 stations was 83/m². Within the mideastern region area of Stations 87, 92, 93, 113, 126, 129, 130 and 149 densities varied from 93/m² at Station 113 to 640/m² at Station 129. Densities at stations

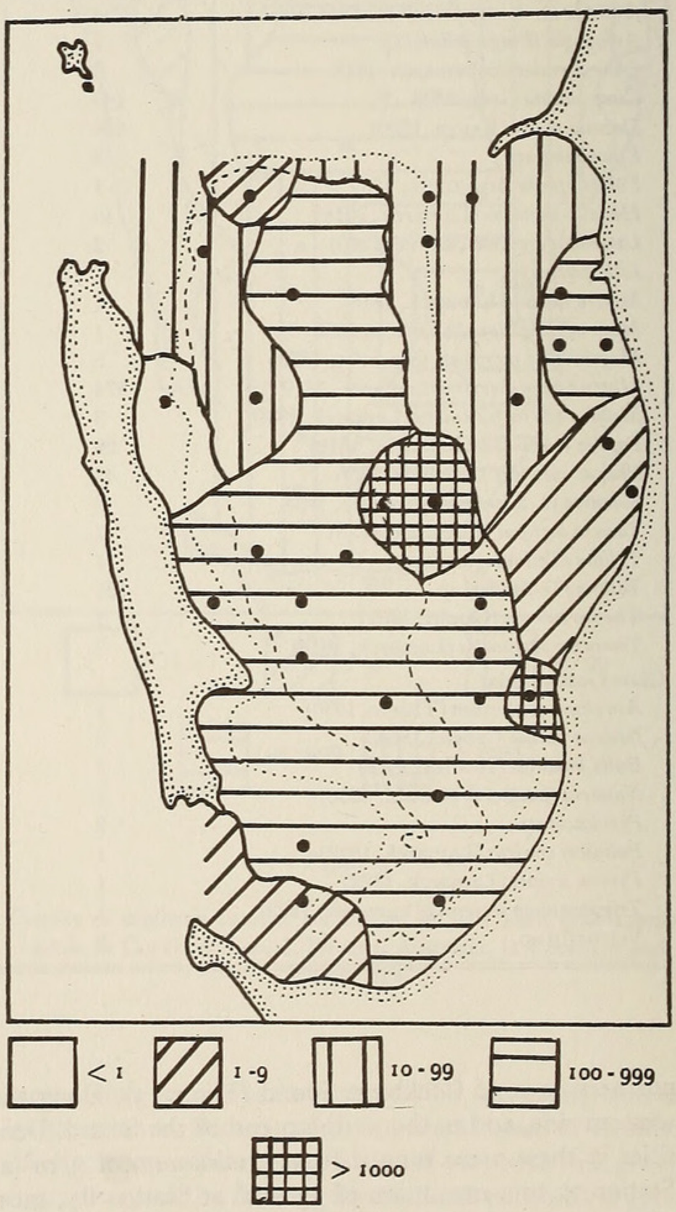

Figure 5

Density of *Musculista glaberrima* (no./m²) collected in Van Veen grab samples made in Cockburn Sound, Western Australia, in February and March 1978 within the mideastern region averaged $252/m^2$; outside that area densities averaged only $40/m^2$. The biomass of *M. glaberrima* in the mideastern zone ranged from $2\,g/m^2$ at Station 87 to $508\,g/m^2$ at Station 129. In general, the stations with the highest densities also had the highest biomass. Station 87 was an exception. Although the population density of *M. glaberrima* at this station was high ($327/m^2$), the individuals were juveniles and the biomass of the species at this station was only $2\,g/m^2$.

The pattern of high densities and biomasses in the mideastern region of Cockburn Sound is best shown by the distributional maps of *Dosinia incisa* (Figure 6). The species is absent or rare at stations outside the mideastern region, with an average density of only $10/m^2$. For this species Station 87 and 149 are outside the region of high abundance. The stations inside the mideastern region had a mean density of $315/m^2$. Maximum densities were encountered at Station 92 ($650/m^2$) and Station 93 ($667/m^2$). These stations and Station 129 also had the highest biomass figures. High biomass figures were also obtained at Stations 101, 103, 117 and 122, which are outside the region of maximal density. This is caused by the presence of a few large individuals of *D. incisa* in the samples.

The two most abundant molluscs, *Musculista glaberrima* and *Dosinia incisa*, were centered in the mideastern region of Cockburn Sound. The two species were not evenly distributed within this area. *Musculista glaberrima* was most dense at the stations adjacent to the eastern shore of Cockburn Sound. These stations were 87, 126, 130 and 146. The biomass of *M. glaberrima* was concentrated at Stations 126, 129 and 130, all of which were adjacent to one another. Somewhat lower biomass was recorded at Station 146 to the south. In contrast to *M. glaberrima*, the highest densities for *D. incisa* were at Stations 92 and 93 to the northwest. Densities for *D. incisa* at Stations 126 and 129 were only one-third of those recorded at Stations 92 and 93. However, the individuals at Stations 126 and 129 were large and the highest biomasses were recorded at these stations.

The third most abundant mollusc, *Anomia* cf. *A. trigonopsis,* had a distributional pattern similar to that exhibited by *M. glaberrima.* The maps of *Circe sulcata* are similar to those of *Dosinia incisa.*

Thus, all of the distributional patterns examined—density and biomass distributions of all molluscs collected, and the four most abundant molluscs examined individually—are all similar. Density and biomass figures are low in the northern sector of Cockburn Sound, along the western side of the Sound and in the southern end. Maximum densities and biomasses were recorded in the mideastern region of the Sound at Stations 92, 93, 113, 126, 129, 130 and 146. In some species high densities and biomasses were also encountered at Stations 103, 117, 122 and 132 to the west of the main area of high density and biomass readings. There was some variation between species within the mideastern region but this was not significant.

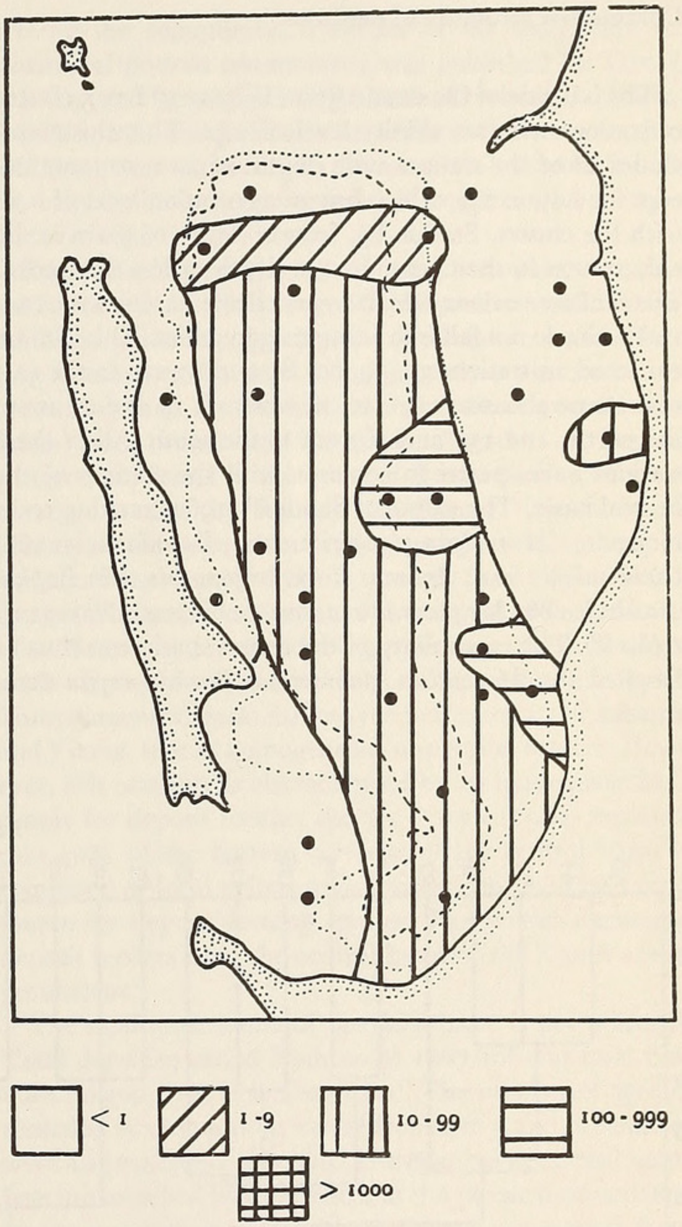

Figure 6

Density of *Dosinia incisa* (no./m^2) collected in Van Veen grab samples made in Cockburn Sound, Western Australia, in February and March 1978

Community structure of molluscs:

The left side of the dendrogram (Figure 7) has a cluster of stations with an affinity level of 0.42. This cluster includes all of the stations with depths of 10 m or more except for station 149, which has an association level of 0.30 with the cluster. Station 85, from a depth of 9.0 m is the only station in the cluster from a depth of less than 10 m. The shallow stations, which were collected around the central basin, do not fall into a single aggregation. This is to be expected, as stations 38, 59, 60, 64 and 87 are to the east of the central basin; 119 is to the west; 16, 17 and 21 are to the north; and 157 and 167 are to the south. All of these stations have species in common with the stations of the central basin. The values of Sanders' (1960) ranking technique are: *Musculista glaberrima* 224; *Dosinia incisa* 166; *Circe sulcata* 114; *Anomia* cf. *A. trigonopsis* 108; *Paphia crassisulca* 88; *Megacardita incrassata* 86; and *Phaxas cultellus* 86. The community of the central basin can thus be labelled the *Musculista glaberrima - Dosinia incisa* community.

Feeding types:

The feeding types for each species are shown on Table 2. Seventeen of the 34 species were infaunal suspension feeders. Sixteen of the remaining species were divided among four feeding categories; predators (5 species), epifaunal suspension feeders (4), grazers (4), and surface deposit feeders (3). Only one species of scavenger was collected in the Van Veen grab samples.

Infaunal suspension feeders, all of which are bivalves, dominated the samples, constituting 82.2% of all individuals collected and 89.5% of the molluscan biomass. The four species of epifaunal suspension feeders, three of which were bivalves, contributed an additional 11.6% of all individuals collected and 7.5% of the biomass (Table 3). Thus 93.8% of all molluscs collected in the study were suspension feeders, dependent on the overlying waters for their food resources. These animals were 97.0% of the total molluscan biomass.

In comparison with the suspension feeders the remaining four feeding categories were minor elements of the

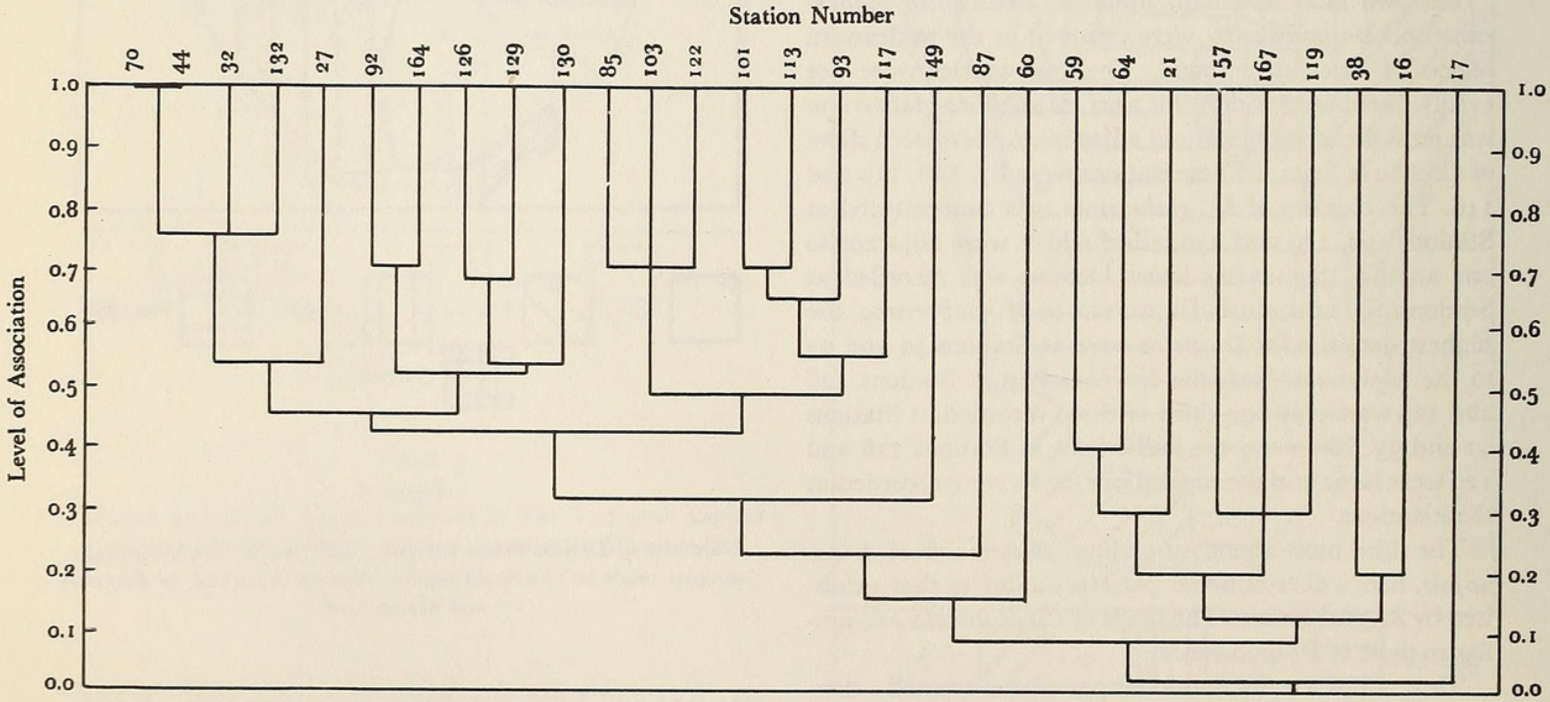

Figure 7

Dendrogram of the 30 stations sampled in Cockburn Sound, Western Australia, in February and March 1978 with a Van Veen grab

Table 3

Characteristics of the feeding types of molluscs collected in Cockburn Sound, Western Australia.

Feeding type	Number of species	Percentage of individuals	Percentage of biomass
Suspension feeders (epifaunal)	4	11.6	7.5
Suspension feeders (infaunal)	17	82.2	89.5
Surface deposit feeders	3	5.8	0.9
Grazers	4	0.3	1.8
Predators	5	0.2	0.2
Scavengers	1	0.0	0.0
TOTALS	34	100.1	99.9

fauna. Surface deposit feeders were the most numerous of the minor feeding categories with 5.8% of all individuals (Table 3) and grazers were the largest biomass component, with only 1.8%. Together the four feeding categories of surface deposit feeders, grazers, predators and scavengers accounted for only 6.3% of the individuals collected and 2.9% of the biomass.

DISCUSSION

Molluscs dominated the study, comprising 72.19% of all individuals collected and 89.56% of the biomass. Among the molluscs the four most common species (*Musculista glaberrima, Dosinia incisa, Anomia* cf. *A. trigonopsis,* and *Circe sulcata)* constituted 95.8% of the molluscan biomass. The dominance of a few species in an ecosystem is a common feature and is not limited to Cockburn Sound. Working in Buzzards Bay, Massachusetts, on the American northeast coast, SANDERS (1960) found that 2 species, the mollusc *Nucula proxima* and the polychaete *Nephthys incisa,* were 76.1% of all individuals collected. DRISCOLL & BRANDON (1973) later looked at the molluscs of the northwestern area of Buzzards Bay. Four facies were investigated, three of which were characterized by fine sediments with ø values of 2.5 or greater. In each of the fine sediments the three most common molluscs were 85.0 to 94.2% of all individuals collected. Working in Western Port, Victoria, COLEMAN (1976) recorded the top 12 of 121 species as 66% of all individuals.

The dominance of one or a small group of species in a community has led to their use as indicator species to characterize the community. A review of the early work in marine softbottom communities was published by THORSON (1957). The molluscs of the central basin of Cockburn Sound fit into the classical scheme for delineating marine softbottom communities. In the case of Cockburn Sound the community is designated the *Musculista glaberrima*-*Dosinia incisa* community.

RHOADS & YOUNG (1970) proposed a trophic amensalism hypothesis in which deposit feeders on a mud bottom inhibit populations of suspension feeding species by clogging filtering mechanisms, burying newly settled larvae or preventing their attachment, or by preventing sessile epifauna from attaching. Three distributions of trophic groups were found in the areas of Buzzard's Bay, Massachusetts, studied by Rhoads and Young: (1) areas of homogeneous suspension feeding groups; (2) those of homogeneous deposit feeding groups; and (3) mixed groups. The molluscan fauna of the central basin of Cockburn Sound is composed of 95.7% suspension feeders, 4.1% deposit feeders and 0.2% of other feeding types. Thus, the central basin fits into the first category of Rhoads and Young, that of homogeneous suspension feeders. However, this category is characterized by an inadequate food supply for deposit feeding species. NUNN (1966) reported that 50% of the bottom material of the central basin is composed of fecal pellets which should supply a rich food source for deposit feeding species. The factors excluding deposit feeders from the central basin of the Sound are as yet unclear.

The molluscan fauna of the deep basin is not uniform. Total densities varied from 20 to 1367/m^2 and total biomass ranged from 2 to 2027 g/m^2. The number of species recorded at each station varied from 1 to 9 and the indices were also markedly different. The changes in animal numbers are matched by differences in the physical parameters of the environment. Depths of the stations varied from about 9 to 20 m. Sediment characteristics were also variable; the ø values ranged from 2.6 to 4.8 and the percentage of silts and clays from 30.0 to 87.8. There was no clear correlation between animal densities and any of the physical parameters measured. We believe this is due to the small numbers of stations sampled in the deep basin. A more intensive investigation of the deep basin should disclose the factors causing variations in animal densities.

In an unpublished taxonomic survey of Cockburn Sound based on samples made from 1956 to 1960, WILSON, KENDRICK & BREARLEY (in prep.) list 13 species of molluscs as being characteristic of the central basin. All except two, *Nuculana verconis* and *Pecten modestus,* were collected in the present study, but freshly dead shells of both were found. There is some evidence that the population density of *N. verconis* is erratic. The species may alternate between increasing its density markedly during favourable periods and suffering decreases during unfavourable times. Fluctuations such as this have been recorded in bivalve molluscs by Coe (1957). The population of *P. modestus* was reduced by commercial fishing conducted circa 1970, but the fresh shells collected in 1978 indicate the presence of a viable population of this species in the central basin of Cockburn Sound. Thus, the absence of 2 of the species that Wilson, Kendrick and Brearley considered to be characteristic of the central basin can be easily explained, and there is no evidence of substantial changes in the molluscan fauna of the central basin in the last 20 years.

Wilson, Kendrick & Brearley (in prep.) considered 12 gastropods to be characteristic of the *Posidonia* beds on the eastern shelf. Only one of these species was collected in this study. *Posidonia* has largely disappeared from the eastern shelf, probably as a result of industrial development (Scott, 1976). With the disappearance of the seagrass the characteristic molluscs have disappeared also. The species have not been lost to Cockburn Sound as they still occur on the seagrass beds of Parmelia Bank, the southern flats and the fringes of Garden Island. Wilson, Kendrick & Brearley (in prep.) recorded the species characteristic of the central basin in isolated sand patches on the eastern shelf. These species have become more common on the shelf as the amount of sand bottom increased.

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